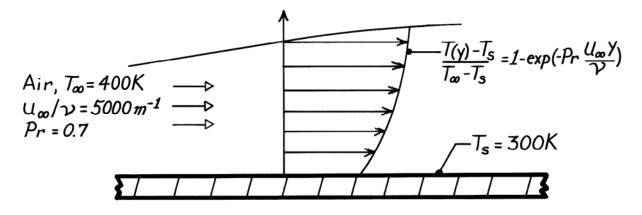
PROBLEM 6.3

KNOWN: Boundary layer temperature distribution.

FIND: Surface heat flux.

SCHEMATIC:



PROPERTIES: *Table A-4*, Air ($T_s = 300$ K): k = 0.0263 W/m·K.

ANALYSIS: Applying Fourier's law at y = 0, the heat flux is

$$\begin{aligned} q_{s}'' &= -k \frac{\partial}{\partial} \frac{T}{y} \bigg|_{y=0} = -k \left(T_{\infty} - T_{s} \right) \left[\Pr \frac{u_{\infty}}{v} \right] \exp \left[-\Pr \frac{u_{\infty} y}{v} \right]_{y=0} \\ q_{s}'' &= -k \left(T_{\infty} - T_{s} \right) \Pr \frac{u_{\infty}}{v} \\ q_{s}'' &= -0.0263 \text{ W/m} \cdot \text{K} \left(100 \text{K} \right) 0.7 \times 5000 \text{ 1/m.} \\ q_{s}'' &= -9205 \text{ W/m}^{2}. \end{aligned}$$

COMMENTS: (1) Negative flux implies convection heat transfer to the surface.

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(2) Note use of k at T_s to evaluate q_s'' from Fourier's law.

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